OIPE JC29 JAN 29 2002 PATENT & TRADEMARK OFFICE

Contact Pressure System

This invention relates to a contact pressure system that can be used especially for continuously variable transmissions, a continuously variable transmission with a contact pressure system, as well as a method for operating such contact pressure systems and/or continuously variable transmissions.

Continuously variable transmissions, as well as contact pressure systems for such continuously variable transmissions and methods for the operation of such continuously variable transmissions and contact pressure systems are known. In a known continuously variable transmission that can be used especially as a motor vehicle transmission, there are provided two pairs of conical disks whose conical disks are arranged so that they can be moved relative to each other. An endless loop means is placed around the pairs of conical disks. The gear ratio between those pairs of conical disks is achieved by means of coordinated adjustment of the particular pairs of conical disks, specifically, in such a way that the spacing between the conical disks of the first pair of conical disks is enlarged when the spacing between the conical disks of the second pair of conical disks is reduced and conversely. To retain a gear ratio that has been set, one uses a contact pressure system with a torque sensor which essentially is loaded by a moment that, in terms of magnitude, also exists at the input side set of conical disks. This torque, acting on the torque sensor, is converted, via a ramp arrangement, into a linear force, which acts upon the set of conical disks. The gear ratio is essentially retained in cooperation with a force that acts on the set of conical disks from the endless loop

means.

The object of the invention is to produce a differently designed contact pressure system, a differently designed continuously variable transmission, as well as a differently designed method for the operation of a contact pressure system or a continuously variable transmission.

In accordance with a particular aspect, the object of the invention is to produce a contact pressure system for continuously variable transmissions wherein the contact pressure force can be adjusted in accordance with or in approximation to the current requirement with a high degree of operational reliability.

In accordance with a particular aspect, the object of the invention is to produce a differently designed contact pressure system, a differently designed continuously variable transmission, as well as a differently designed method for the operation of a contact pressure system or a continuously variable transmission, by which under different load directions, as well as load direction changes, a high degree of operational reliability is achieved.

The problem is solved by a contact pressure system which has at least one feature of the features that are described in the following description or described in the claims, or that are shown in the Fig.s.

The problem is further solved by a continuously variable transmission which has at least one feature of the features that are described in the following description or described in the claims, or that are shown in the Fig.s.

The problem is further solved by a method for operating a continuously variable transmission and/or a contact pressure system, that has at least one feature

of the features described in the following description or described in the claims, or that are shown in the Fig.s.

The problem is particularly solved by a contact pressure system in accordance with claim 1 or in accordance with claim 2 or in accordance with claim 3 or in accordance with claim 4 or in accordance with claim 5 or in accordance with claim 6 or in accordance with claim 7 or in accordance with claim 8.

The problem is further solved by a continuously variable transmission in accordance with claim 81.

The problem is further solved by a method in accordance with claim 82.

Preferred further embodiments of the invention are the subject matter of the dependent claims.

The invention is particularly solved by a contact pressure system that has a torque sensor system, that, on the input side, can be loaded with a torque, and that, on the output side, produces a contact pressure force which depends on the torque that is applied on the input side. This contact pressure system further has a transmission unit that transmits that torque or that force. By a transmission unit in the sense of the present invention, what is especially to be understood is a unit that is arranged within a force or moment transfer section and that causes the output moment or the output force of that unit to be changed with respect to the input moment or the input force.

In particular, in the sense of the present invention, the transmission unit is to be understood to be a gearbox unit. The transmission unit is preferably formed mechanically. Thereby it is not intended to restrict the invention in any way. The

transmission unit can also be hydraulic or hydraulic and mechanical or in other ways.

It is especially preferred in accordance with the present invention that the contact pressure system operates that in a motor vehicle with an internal combustion engine and a continuously variable transmission, a force or a moment introduced from the internal combustion engine into the contact pressure system is increased within the contact pressure system and the output side of the contact pressure system loads the continuously variable transmission.

This problem is further solved by a contact pressure system in accordance with claim 2.

In accordance with the invention, there is provided, especially, a contact pressure system for a continuously variable transmission which system is associated with at least one set of disks of the continuously variable transmission. Thereby it is provided that the contact pressure system has a torque sensor system or a torque sensor, and that the torque that is introduced on the input side into the torque sensor is different from the torque that is transmitted between the sets of disks, in particular by an endless loop means.

It should be noted that, in the sense of the present invention, by input side is to be understood preferably the side of the contact pressure system or the torque sensor that, in the flow of force or the flow of torque, faces an internal combustion engine when a contact pressure system in accordance with the invention is utilized in a motor vehicle with an internal combustion engine in order to generate a contact pressure force on a continuously variable transmission of that motor vehicle.

It should further be noted that by contact pressure system in the sense of the

present invention is to be understood a system that is loaded with a torque on the input side and that on the output side produces a force that is especially preferred to be linearly directed. The invention of course should not be restricted to such contact pressure systems. The contact pressure system in accordance with the invention can especially be designed as a dry operating or a wet operating contact pressure system.

The problem is further solved by a contact pressure system in accordance with claim 3.

In accordance with the invention there is particularly provided a contact pressure system with at least one torque sensor system, whereby the contact pressure system or the torque sensor system has ramps that extend at an angle with respect to the circumferential direction of the contact pressure system or the torque sensor system, and that at least cooperate in bringing about a situation where the contact pressure force produced by the contact pressure system is dependent upon the torque. The torque dependence applies especially to a torque with which the contact pressure system or the torque sensor is loaded. For different torque directions or rotation directions preferably different ramps are provided. Further, preferably different freewheels are provided for the different rotation directions. The differing freewheels are in that case coupled together and, to be sure, in such a way to ensure that both freewheels will not simultaneously block a rotational movement and thereby through the cooperative action of the freewheels movability in both directions of rotation are simultaneously blocked.

It should be noted that by the term “at an angle to the circumferential direction”

in the sense of the present invention, it is especially to be understood that the angle is given within a circumferentially defined curved surface and/or by an angle to such a fictitious curved surface.

The problem is further solved by a contact pressure system in accordance with claim 4.

In accordance with the invention, there is particularly provided a contact pressure system with at least one torque sensor system, whereby the contact pressure system or the torque sensor system has at least one double freewheel system that cooperates with the torque sensor.

By a double freewheel or a double freewheel system, in the sense of the present invention, is especially intended a freewheel system that has differing freewheels that are so coupled together that, as a function of at least one position of the first of the freewheels, the position or the position range of the other of the freewheels can essentially be determined unambiguously. That position range includes only a part of all possible positions of the other freewheel. In particular, in accordance with the invention a double freewheel system is to be understood to be a system with two freewheels that are coupled together in such a way that a position is given in which both are defined to be open. Preferably, the freewheels are provided for different rotation directions so that the first freewheel can transmit a torque in a first direction of rotation, and that the second freewheel can transmit a torque in a second direction of rotation opposite to the first one. The freewheels are preferably coupled with a ramp system of a torque sensor system.

The problem is further solved by a contact pressure system in accordance with

claim 5.

In accordance with the invention, there is provided, in particular, a contact pressure system with a torque sensor system that, on the output side, can produce a contact pressure force that, for example, is provided to load a set of disks of a continuously variable transmission, where the (contact pressure) force is dependent upon a torque that is applied on the input side of the contact pressure system or the torque sensor system, as well as on the direction of rotation of that torque. Further there is provided a switchover device that, when the direction of rotation is changed, switches over between predetermined control characteristics that depend on the direction of rotation.

A torque sensor system or a torque sensor in the sense of the present invention is particularly formed so that it has, respectively, two different ramps or ramp arrangements, of which one is intended for deceleration and one for acceleration. An arrangement of several ramps is especially designed in such a way that the ramps have a substantially identical contour.

In a motor vehicle with a contact pressure system in accordance with the present invention assembled with a continuously variable transmission, acceleration is particularly provided when an internal combustion engine that is arranged on the input side of the continuously variable transmission loads it or supplies it with energy, so that it causes to make available energy or torque at the output side of the continuously variable transmission that can drive a motor vehicle. Deceleration is particularly provided in a motor vehicle with a contact pressure system in accordance with the present invention as well as continuously variable transmission when a

torque is introduced into the continuously variable transmission at the output side of the continuously variable transmission, and which is conducted in the direction of the internal combustion engine through the continuously variable transmission in the drive train. Acceleration is particularly provided in a motor vehicle when a fuel proportioning member, such as a gas pedal, is operated, and deceleration is provided when the fuel proportioning member is not operated during movement of the motor vehicle.

The rotation-direction-dependent control characteristics preferably control the contact pressure force and are at least partly determined, in a particularly preferred manner, by the design or the geometry of the ramps, thus particularly at least determine the drive ramp or the retard ramp.

The problem is further solved by a contact pressure system in accordance with claim 6.

In accordance with the invention there is provided, in particular, a contact pressure system with a torque sensor system as well as with a device that guarantees that at least one of the respective ramps or the respective ramps of the torque sensor, thus, particularly, the drive ramps and the retard ramps, lie in a power transmitting direction with each of the adjoining power transmitting components. The apparatus further guarantees that as a function of the load direction of the contact pressure system or the torque sensor system, one of the respective load-direction-determined ramps will be arranged in the power flow path. In particular, there is provided in accordance with the invention one or several retard ramps that are connected in the power flow path when a continuously variable transmission or a

motor vehicle is operated in deceleration and that one or several drive ramps are connected in the power flow path when the continuously variable transmission for the motor vehicle is operated during acceleration. In accordance with the invention it is especially provided that the apparatus guarantees that a transmission member will in each case lie in contact with one of the ramps adjoining the transmission member.

A transmission member in the sense of the present invention is particularly an element that is provided in a moment sensor, and between relatively movable parts, such as ramps of a ramp arrangement, arranged in such a way that a torque can be transmitted between those parts by the transmission member. The transmission member is particularly arranged between two ramps that are in each case arranged in the same direction of rotation. It is certainly also preferred that the transmission body be arranged between a ramp and a surface not shaped as a ramp.

A transmission member in the sense of the present invention is particularly formed as a roll or roller or as a ball or in other ways. Particularly preferred in the sense of the present invention is a transmission member that is formed in such a way that its surface contour makes possible rolling or sliding of the transmission member on another body.

The apparatus particularly guarantees that the transmission member constantly lies against one of the surfaces of the torque sensor system, which are arranged to be movable with respect to each other and between which the transmission member transmits or can transmit torque when the corresponding direction of rotation is provided in which the torque is to be transmitted by that transmission member.

The problem is further solved by a contact pressure system in accordance with claim 7.

In accordance with the invention there is particularly provided a contact pressure system with a torque sensor system whereby the torque sensor system has differing ramps. The torque sensor system particularly has at least a first ramp by which a torque is transmitted when the torque sensor system is loaded in a first direction of rotation, as well as at least a second ramp, by which a torque is transmitted or is to be transmitted, when the torque sensor system is loaded in a second direction of rotation opposite to the first one. The first ramp is particularly a retard ramp and the second ramp is particularly a drive ramp, or conversely. In accordance with the invention there is further provided a freewheel unit that has at least one first freewheel associated with the first direction of rotation, as well as a second freewheel associated with the second direction of rotation. In accordance with the invention, it is guaranteed that jamming of the free wheels by a reversal of the torque sensor is prevented.

By a reversal of the torque sensor in the sense of the present invention is to be understood that in a (rapid) change of load direction, the moment sensor will return to a null position from a ramp or flank, such as the drive flank or the retard flank, and subsequently is moved to the other of those flanks or ramps to the currently needed position. In doing so angular play >180° can occur that can lead to impacts in the drive train and in that case possibly a resulting loss of comfort or damage to components. Those and also other negative influences are certainly particularly avoided by the invention. In particular, it is further guaranteed in

accordance with the present invention that the freewheels in such a reversal will be jammed against each other.

The problem is further solved by a contact pressure system in accordance with claim 8.

In accordance with the invention there is particularly provided a contact pressure system with a torque sensor system that has a spring system, whereby the spring system operates cooperatively with the torque sensor system. Preferably, the torque is introduced into the torque sensor system on the input side through the spring system or through a part of the spring system. Especially preferred is a provision that the torque sensor system is coupled, only through the spring system or a part of the spring system, with the drive side, that is, particularly the side or with components that are arranged on the side, which in a motor vehicle with a contact pressure system installed on a continuously variable transmission of the motor vehicle is turned toward or which faces away from the continuously variable transmission, so that torques between input side components and the torque sensor system in the direction of the output side are transmitted only by the spring system or a part of the spring system.

In accordance with a preferred embodiment of the invention, the gear ratio of the transmission unit is adjustable. It is particularly preferred that the transmission ratio apparatus is formed as a gear unit and, to be sure, especially as a planetary gear, whereby the transmission ratio of the transmission of that type is set so that of

the components carrier, sun gear, and ring gear, a structural component is coupled on the drive side, in particular in the direction of the internal combustion engine, a further component is coupled with the torque sensor system, and the third of those components is loaded by an adjusting or control device or in some other way, which operates to control the gear ratio between both of the other components. Particularly preferred is provided that the sun gear is loaded by an internal combustion engine of a motor vehicle, the carrier of the planetary transmission loads a torque sensor, and the ring gear is loaded by a control or adjustment mechanism or in other ways. If necessary, the planet gear is arranged to be non-rotatable.

The gear ratio of the transmission unit or of the gear unit is constant or not constant.

Preferably, the differential moment between the carrier moment and the input moment, or the moment of the sun gear, is returned as a blind moment into the planetary gear by the moment sensor power take-off, or the output side of the moment sensor and the ring gear of the planetary transmission. In accordance with a preferred embodiment of the invention, the planet set of a planetary gear is not impacted by the power train output but rather by the power train moment.

The transmission unit, which, in particular, is made as a gear unit, and which in a particularly preferred manner is formed mechanically, is in accordance with a preferred embodiment of the invention arranged on the input side of the torque sensor, thus, in a contact pressure system installed in a motor vehicle, in particular, between the torque sensor and the internal combustion engine of the motor vehicle. Preferably, the transmission unit or the gear unit is provided on the output side of the

torque sensor system ,or a gear unit is provided both on the input side and the output side of the torque sensor system.

In accordance with a preferred embodiment of the invention, the gear unit is a so-called round or non-round gear arrangement. Particularly preferred, all torques that are introduced into the gear unit or that derived from the gear unit are torques with respect to the same or, from time to time, a concentric axis of rotation.

When a planetary gear is used in the sense of the invention, the planets in particular can be designed as single stage planets or as multistage planets.

If applicable, a contact pressure system in accordance with the invention is provided with torque sensors and a gear unit, further with a freewheel system that has one or several individual, in particular conventional, freewheels, or a double freewheel, or a freewheel system designed in some other way.

Particularly preferred are different torques that are applied to the gear unit or the interfaces of the gear unit to the adjoining components, whereby the largest of those torques is transmitted between the gear unit and a torque sensor in accordance with the inventive contact pressure system.

Preferably, the torque is raised on the input side of a torque sensor, which is particularly associated with a predetermined set of disks of a endless loop means or a continuously variable transmission of a motor vehicle, so that, particularly in this case, a unit is provided that has an input moment that is smaller than its output moment, so that the input moment of the torque sensor is greater than the input moment of that unit. It is not thereby intended to restrict the invention. It is further preferred that the output moment or the output force of the torque sensor is reduced

so that a correspondingly diminished force will load a set of disks of a continuously variable transmission or a endless loop means.

The contact pressure system and/or the torque sensor, in the sense of the present invention, is conFig.d hydraulically and/or mechanically, or in some other way.

Particularly preferred, the contact pressure system as well as the torque sensor is conFig.d mechanically so that the force or moment transmission is brought about by mechanical parts, specifically, from the input side of the contact pressure system all the way to the set of disks.

The gear unit of the contact pressure system can have round or non-round gears or it can be conFig.d in some other way.

In accordance with a particularly preferred embodiment of the invention, the non-round gears are the gears of a planetary gear.

Preferably, a portion of the contact pressure force that is produced by the contact pressure system in accordance with the invention, and which depends on the gear ratio of a continuously variable transmission, is produced by the selection and/or configuration of the gear unit that the contact pressure system exhibits.

Preferably, the contact pressure system generates a contact pressure force that depends both on the gear ratio of a continuously variable transmission and on the moment with which that contact pressure system or the continuously variable transmission is loaded, where the moment-dependent portion and the gear-ratio-dependent portion of the contact pressure force are produced in different subunits. The following is provided, in particular: the moment-dependent of the contact

pressure force is produced via a ramp system, where those ramps in particular are designed in a linear fashion, and the portion that depends on the gear-ratio [is produced] via a planetary gear with nonround teeth which, in particular, is series-connected in front of a torque sensor with ramp system.

In a particularly preferred manner, at least one of the nonround gearwheels has an elliptical shape. Preferably, the gear unit is a planetary gear where the sun gear as well as the planet wheels in each case are ellipsoidal and where the hollow wheel essentially is star-shaped with essentially rounded transitions.

Preferably, an invention-based contact pressure system has a torque sensor with differing ramps plus a unit that determines or controls via which of those ramps a torque can be transmitted or is transmitted via a contact pressure system. This unit in particular is so designed that even in case of (fast) load changes, a torque transition can be facilitated in accordance with those load changes.

The following is provided in a preferred manner: a part of those ramps are thrust ramps and a part of those ramps are traction ramps. The following is possibly provided: those thrust ramps and traction ramps are at least partly uncoupled from each other, specifically, in such a way that they are arranged so that they can be moved with relation to each other. By "uncoupled" we mean in particular that no coupling or connecting elements are provided or that relative mobility is guaranteed in spite of the provided coupling or connecting elements. This relative mobility can be facilitated by means of a spring system.

Preferably, in invention-based contact pressure system has a torque sensor with ramps against which rests an additional component of the torque sensor. This

additional component is guided actively or passively on that ramp so that there is essentially always a contact between that ramp and that component.

Active guidance in the sense of that invention exists in particular when a component, especially one reacting to a load, such as a spring, brings about the guidance [tracking] action, while a passive guidance exists in the sense of that invention particularly when a working, especially a load-generating component brings about the tracking guidance.

A preferred contact pressure system has at least one torque sensor with a first device and a second device. The first device is connected into the flow of force when a torque acts upon the torque sensor in a first direction of rotation and the second device is connected into the flow of force when a torque acts upon the torque sensor in a second direction of rotation opposite to the first one. In particular, it is provided in accordance with the invention that a torque can be transmitted via the first or second device that is connected into the flow of force.

The first device preferably has a first ramp and the second device preferably has a second ramp. In a particularly preferred manner it is provided that the first ramp is arranged so that it can be swung with respect to the second ramp.

The first ramp is preferably connected or coupled to the second ramp via a spring element or a damper element. The ramps in accordance with the invention contact pressure system – and, in particular, the first ramp and/or the second ramp – preferably extend in the circumferential direction of the torque sensor or at an angle with respect to that circumferential direction or in the circumferential direction and in the radial direction. Possibly, the ramps are so designed that, with respect to the

torque sensor, differing positions are given on the surface of the ramps and different axial positions are associated with those positions.

Preferably, the first device has a first freewheel and the second device has a second freewheel. Those freewheels are uncoupled or they are coupled together. The positions of those freewheels are controlled by a common control device that selects both freewheels or by separate control devices or in some other way.

The first and the second freewheels are preferably coupled or connected with each other via a spring system.

During the switch over from the first freewheel to the second freewheel and conversely, one preferably runs through a position in which one can make sure that both freewheels are opened. This position is referred to especially as “open center” in the sense of that invention.

The first and second freewheels are preferably known, conventional freewheels or the freewheels are made as double freewheel.

The first as well as the second freewheels preferably have a clamping body. This clamping body is provided particularly to make sure that it can transmit a torque, in at least one predetermined position, between two components that are arranged so that they can be moved with relation to each other. The clamping body in particular is made as a ball or as a roll or the like. Preferably, a common retainer is provided for the clamping bodies of the first freewheel, as well as a common retainer for the clamping bodies of the second freewheel.

In accordance with a preferred embodiment of the invention, the clamping bodies of the first freewheel are arranged with those of the second freewheel in a

common retainer.

The clamping bodies of the first freewheel and/or the clamping bodies of the second freewheel preferably cooperate with a profiled and/or nonprofiled with two profile tracks. Preferably it is provided that at least one of those profiled tracks is arranged radially outside the clamping bodies of the particular freewheel that cooperate with that profiled track.

The following is provided in particular in the sense of that invention: the first freewheel is associated with a thrust ramp system or has a thrust ramp system and the second freewheel is associated with a traction ramp system or has a traction ramp system or conversely.

Preferably, in each case, at least one clamping body of the first and of the second freewheels cooperates with a profiled track where at least one of those profiled tracks is arranged radially inside the clamping bodies which cooperate with that track.

Preferably, there is provided at least one clamping body that is associated both with the first and the second freewheel. In particular, that clamping body cooperates both with a track of the first freewheel, that is made nonprofiled or profiled, and with a corresponding or differently designed track of the second freewheel.

Preferably, there is provided a first nonprofiled track that cooperates with at least a first clamping body of the first freewheel, as well as a second nonprofiled track that cooperates with at least a second clamping body of the second freewheel, where the first and the second nonprofiled tracks are connected with each other in a

nonrotating fashion. The first and the second nonprofiled tracks are spaced apart from each other or not spaced apart from each other in the radial direction.

Preferably, the first freewheel has a first, profiled track and the second freewheel has a second, profiled track, and those profile tracks in each case cooperate with a first clamping body or a second clamping body or with a common clamping body, and that first and that second profiled tracks are spaced apart or are not spaced apart in the radial direction.

The first profiled track is preferably connected with the second profiled track in a nonrotating manner or it is arranged so that it can be moved with relation to that second profiled track.

A preferred contact pressure system has a retaining device that retains predetermined clamping bodies in contact with a second running track or track and that is possibly spaced away from a first running track, where that first and that second running tracks as well as those clamping bodies in each case are associated with the same freewheel. Possibly, a first retaining device is provided for the first freewheel and a second retaining device is provided for the second freewheel.

Preferably, a contact pressure system has a catch device that works between at least one clamping body and at least one track, so that, under predetermined conditions, a movement of that track exerts a force upon the clamping body, specifically, in the circumferential direction. This force is brought about in a particularly preferred manner under predetermined conditions, when the first freewheel and/or the second freewheel is switched into an opened position. In a particularly preferred manner, the catch device is made as a friction device or has a

friction device. In particular, the catch device has a friction ring or a friction disk that extends essentially concentrically to the freewheel or concentrically to the torque sensor.

Preferably, the clamping bodies, in case of a force transmission and/or moment transmission, are clamped via the particular freewheel between two tracks, where the term "clamps" in that sense also especially means that those particular clamping bodies press against both tracks in a form-locking and/or friction-locking manner. In a particularly preferred manner, the clamping bodies are arranged between those two tracks, specifically, in the radial direction.

A preferred, invention-based freewheel system has differing clamping bodies that are associated with differing freewheels and that are spaced apart in the axial direction of the freewheel system or a torque sensor. Possibly, the clamping bodies are spaced apart – alternately or additionally – in the radial direction.

Preferably, clamping bodies of the freewheel system – that are associated with the same freewheel or different freewheels – are arranged in series and extend particularly in the circumferential direction of that freewheel system or a torque sensor system.

In accordance with a preferred embodiment of the invention, at least one track of the freewheel system is coupled with a component of the torque sensor and/or a set of disks, specifically, with a mobile component.

In a preferable manner, at least two tracks – that are associated with different freewheels – are arranged so that they will be mobile with respect to each other.

Particularly, at least one track of the first freewheel is arranged fixedly with

respect to a track of the second freewheel and another track of the first freewheel [is arranged] so that it can be moved with relation to another track of the second freewheel.

Preferably, several clamping bodies of a freewheel touch each other so that they can possibly load each other, specifically, in the circumferential direction of the torque sensor.

In accordance with a preferred embodiment of an invention-based contact pressure system, the latter has a freewheel system with two freewheels or a double freewheel, where the first clamping body or the first clamping bodies of the first freewheel are arranged at a predetermined phase angle with respect to the clamping body or clamping bodies of the second freewheel and are possibly retained at that phase angle. A predetermined first running track of the first freewheel, which is associated with at least one predetermined first clamping body, is arranged with relation to a second running track of the second freewheel – which is associated with at least a second predetermined clamping body – at a predetermined phase angle. In accordance with the invention, it is provided especially that the phase angle between those clamping bodies is smaller than the phase angle between those running tracks.

The invention-based freewheel system or an invention-based freewheel in particular is designed as double clamping roll freewheel with external stars and a common retainer or as double clamping roll freewheel with internal stars and a common retainer or as double clamping roll freewheel with common clamping bodies or as double clamping body freewheel with a common retainer or as some other

freewheel system or as some other double clamping body or clamping roll freewheel system.

Preferably, the invention-based freewheel is so designed that there is a first engagement in the vicinity of a switch over point, in particular, in case of a small circumferential backlash, where that switch over point in particular is a position in which both freewheels are not engaging.

Preferably, the clamping rolls or clamping bodies are constantly kept against a track by means of spring device or by means of centrifugal force or by means of form-locking arrangement or in some other way, which are associated with those particular clamping rolls or clamping bodies.

Preferably, there is provided a friction element that, at least in the area of the "open center," in other words, when both freewheels are not engaging, by way of friction connects with each other the clamping bodies or clamping rollers with a nonprofiled common running track of the two freewheels so that a rotation connection exists due to the action of the corresponding friction force. The following is provided here in particular: in case of a relative turning of that running track, associated with both freewheels, with respect to the particular other running tracks, using that friction connection, the clamping rolls or clamping body rows are switched into a first engagement.

Preferably, in accordance with the invention, there are provided, with the particular freewheel, clamping rolls or clamping body rows which have one or several clamping bodies or one or several clamping rolls. Those clamping rolls or clamping body rows are preferably, in turn, connected with each other by retainers or contact

each other so that the motion of one of those clamping bodies will bring about a motion of a neighboring clamping body.

In accordance with a special embodiment of the invention, the common clamping roll or clamping body row is associated with both freewheels of the freewheel system; differing engagement areas are given for the different freewheels. Those different engagement areas differ especially in that the torque can be transmitted, in one of the freewheels, in differing positions of that row of clamping bodies.

Preferably, a common clamping body or clamping roll row, associated with both freewheels, defined under predetermined conditions, is kept raised off a common running track whereby that holding action is preferably brought about via a common retainer.

In accordance with a preferred embodiment of the invention, a friction element is provided which is designed as a structural unit with a possibly existing retainer – in the area of the "open center," which connects the clamping bodies or clamping rolls in a friction manner with a nonprofiled, common running track so that there is a rotary coupling.

Possibly, at least one running track of the freewheel system is connected with a mobile part of the continuously variable transmission, in particular, with a disk or a set of disks of that continuously variable transmission. It is further preferred that at least one running track of the freewheel system be formed by a component of the continuously variable transmission or of the torque sensor or of a set of disks or is arranged on it.

The following is further preferred: differing running tracks of the freewheel system be made up of components of the moment sensor or be coupled to that moment sensor or be arranged on that moment sensor.

It is further preferred that a common running track, which is associated with the differing freewheels, be arranged on a mobile part of the moment sensor or be coupled with it.

The invention of course is not restricted thus. In particular, the running tracks, especially the running tracks that are mobile with respect to each other, can also be made up of other parts or may be arranged on other parts.

A running track or a track of the freewheel system, in the sense of that invention, in particular, is a surface against which a clamping body is supported when – via that clamping body and that surface – a force can be transmitted or when the freewheel is in a closed position and/or the surface that adjoins the previously mentioned surface and which can possibly guide the clamping body [sic].

By a profiled track or running track, in the sense of that invention, we particularly mean a track that has elevations and depressions.

By a unprofiled or nonprofiled track, in the sense of that invention, we particularly mean a track whose surface is essentially free of any elevations and depressions or that is essentially made level.

Preferably, an invention-based contact pressure system or a freewheel system or a torque sensor is provided, in each case, for a set of disks of a continuously variable transmission or a common contact pressure system or a freewheel system or torque sensor system is provided for several differing sets of disks of a

continuously variable transmission.

An invention-based contact pressure system is particularly provided for a continuously variable transmission in order to maintain a predetermined, adjusted gear ratio. This continuously variable transmission preferably has, in addition, an adjusting system by means of which the gear ratio can be adjusted. Such an adjusting system is preferably made hydraulically or mechanically or in some other way. In a particularly preferred manner, the contact pressure system also works in case of an adjustment of the gear ratio and in that case, in particular, the forces of the adjusting system and of the contact pressure system are superposed for the adjusting function.

Preferably, an invention-based contact pressure system has a spring system which makes sure that the particular ramps of the torque sensor or at least one ramp of the torque sensor here, in the direction of force transmission, rests against at least one component that adjoins the particular ramp, such as force transmission body, and which ensures that – as a function of the direction of loading of the torque sensor – the particular ramp, designated for that direction of loading, such as traction ramp or thrust ramp, will be arranged in the flow of force.

To ensure that an adjoining component, such as a force transmission body, rests against a particular ramp, it is in particular so arranged that that force transmission component rests against one of the surfaces between which it transmits that force or that torque when it is connected into the force of flow or the torque flow.

It might be noted that, if in the sense of the invention, we talk about ramp or flank, we mean especially a single ramp or a pair of ramps which are associated with

each other and between which a force transmission body is arranged, via which, between those adjoining ramps, a force is transmitted via a torque, when the particular between [ramps] via which is shaped [sic] [switched into] the torque flow, or an arrangement consisting of a ramp and a component with a surface that is not inclined.

Preferably, with the help of the spring system, one can determine or control which ramp, inside the torque sensor, is to be switched into the force of flow or the moment flow.

Preferably, at least one ramp of the torque sensor system is coupled with a spring of the spring system. Preferably, at least one ramp of the torque sensor system is coupled via a spring of the spring system with a component that is loaded by the internal combustion engine.

In a particularly preferred manner, there is provided a spring of the spring system that is arranged between a ramp of the torque sensor and a component that is loaded by the internal combustion engine, where the flow of force from the internal combustion engine to the torque sensor system runs through that spring and, where, in particular, no other components are provided via which that force of flow can be bridged by the spring or by a spring.

Preferably, the spring system has at least one first spring that is arranged between a component, loaded by the internal combustion engine, and a first ramp of the torque sensor system, as well as at least one second spring, that is arranged between a component loaded by the internal combustion engine and a second ramp of the torque sensor system, so that those ramps – especially when a motor vehicle

is in traction operation – can be loaded by the internal combustion engine via those springs.

Preferably, a spring of the spring system is increasingly released with increasing running radius of a endless loop means which is arranged on a set of disks of a continuously variable transmission, which set is associated with that torque sensor.

Preferably, a spring of the spring system has a prestress in case of maximum running radius of the endless loop means which is associated with the set of disks that is associated with that particular spring or with the torque sensor.

The spring system preferably additionally works as vibration damper or as two-mass flywheel (ZMS) or it is integrated into a two-mass flywheel which is arranged in the power train of a motor vehicle,

In the invention-based contact pressure system and/or an invention-based torque sensor is in particular designed in a mechanical fashion.

The force transmission body in the sense of that invention in particular is a roller body, such as a ball, or some other component.

The problem is further solved by a continuously variable transmission in accordance with claim 81.

The problem is further solved by a method in accordance with claim 82.

The term "controlling" in the sense of that invention in particular is to be construed as "regulating" and/or "steering" [controlling], along the lines of DIN [German Industrial Standard]. The same applies to concepts that are derived from the term "controlling."

The claims included in the application are exemplary and are without prejudice to acquiring wider patent protection. The applicant reserves the right to claim additional combinations of features disclosed in the specification and/or drawings.

The references contained in the dependent claims point to further developments of the object of the main claim by means of the features of the particular claim; they are not to be construed as renunciation to independent, objective protection for the combinations of features of the related dependent claims.

Although the subject matter of the dependent claims can constitute separate and independent inventions in the light of the state of the art on the priority date, the applicants reserve the right to make them the subject of independent claims or separate statements. They can, moreover, also embody independent inventions that can be produced from the independent developments of the subject matter of the included dependent claims.

The exemplary embodiments are not to be considered to be limitations of the invention. On the contrary, many changes and variations are possible within the scope of the invention in the existing disclosure, in particular such variants, elements, and combinations and/or materials which, for example, are inventive by combining or modifying single features that are in combination and are described individually in relation to the general specification and embodiments as well as the claims and shown in the drawings, as well as elements or method steps that can be derived by a person skilled in the art in the light of the disclosed solutions of the problem, and which by means of combined features lead to a new object or new method steps or

sequences of method steps, as well as manufacturing, testing and operational procedures.

Particular aspects of the invention will be more specifically explained in the following with reference to the Fig.s, in which the invention is certainly not intended to be restricted.

There is shown:

Fig. 1 an exemplary embodiment of the invention in a schematic representation;

Fig. 2 an exemplary embodiment of the invention in a partial, schematic view;

Fig. 3 an exemplary embodiment of the invention in a partial, schematic view;

Fig. 4 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 5 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 6 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 7 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 8 an open status - rotation angle diagram of an exemplary embodiment of the invention in a schematic view;

Fig. 9 an exemplary embodiment of the invention in a schematic, partial

view;

Fig. 10 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 11 an exemplary embodiment of the invention in a schematic, partial view;

Fig. 12 a force-transmission ratio plot; and

Fig. 13 a force -transmission ratio plot.

Fig. 1 shows an exemplary embodiment of the invention in a schematic representation.

Fig. 1 shows in particular a partial representation of a continuously variable transmission 10 that has a contact pressure system 12.

The continuously variable transmission 10 has two sets of disks, of which Fig. 1 shows one set of conical disks with a first conical disk 14 as well as a second conical disk 16.

Positioned around the sets of conical disks is a endless loop means that in this instance is shown as plate-link chain 18.

Plate-link chain 18 has chain links that are positioned in an articulated manner with respect to the particular adjoining, neighboring chain links. Provided at each of the link positions are rocker member pairs that have two rocker members.

The rocker member pairs 20 each extend through openings 22 that are provided in links 24.

Links 24 arranged in the same chain link each have an identical or a different geometry.

The separation of different chain links is formed identically or differently. Different chain links have identically or differently configured links 24.

The rocker member pairs 20 extend laterally out of the link sets 26 and can be supported at each of their ends 28, 30, can be supported in each case on a conical disk 14, 16 so that the plate-link chain 18 can transmit a torque between the different conical disk pairs, one of which is shown in Fig. 1, by frictional engagement.

The conical disk sets each have a conical disk 16 that is rigidly coupled to a shaft 32 as well as a conical disk 14 that is arranged on shaft 32 in a non-rotational and axially movable manner. Conical disk 16 is arranged both in a non-rotational manner on shaft 32 and also rigidly in the axial direction and is preferably integrally formed with shaft 32.

Shaft 32 is supported by bearing units 34, 36, 38 relative to a housing or a receiving unit 40.

In Fig. 1, the first conical disk of the conical disk set 14, 16 is shown in different axial positions that are indicated by the line 42 or the line 44.

Fig. 1 further illustrates the arrangement of the plate-link chain 18, 18' at those different axial positions. In the axial position indicated by line 42, the plate-link chain is arranged with respect to the set of conical disks in the way illustrated by the reference symbol 18. When the first conical disk 14 has the axial position corresponding with line 44, the plate-link chain is in the position indicated by reference numeral 18'. In case of a larger axial spacing of conical disks 14, 16, plate-link chain 18, 18' is arranged radially further inwardly. In the lower part 46 in Fig. 1, there is shown, on the one hand, the axial position of the conical disks 14, 16 of the

other pair of conical disks, not otherwise shown, and on the other hand one can see the corresponding position of plate-link chain 18.

The position of the first conical disk 14, indicated by line 42' of the other set of conical disks that is not otherwise shown is indicated when the conical disk set illustrated in Fig. 1 exhibits the position shown by line 42 and the position of the first conical disk of the other conical disk set, not otherwise shown, indicated by line 44' is indicated when the illustrated first conical disk 14 exhibits the position indicated by line 44. In a corresponding manner, the plate-link chain exhibits the position relative to the other set of conical disks not otherwise shown, that is indicated by the reference numeral 18" when the plate-link chain is in the position 18 on the illustrated conical disk set 14, 16. Position 18"' of the plate-link chain 18 is provided on the other, not otherwise illustrated set of conical disks when plate-link chain 18 is in position 18' on the illustrated conical disk set.

When the plate-link chain in the illustrated disk set 14, 16 is arranged further radially inwardly, the plate-link chain 18 is arranged on the not illustrated disk set further radially outwardly and conversely.

In that way one can steplessly change different gear ratios.

The contact pressure system 12 is particularly provided to hold a respective set or controlled gear ratio step.

The contact pressure system 12 takes into account the fact that if necessary as a function of the direction of rotation of shaft 32, different contact pressure forces must act on the movably arranged conical disk 14 to hold the gear ratio that was set.

The contact pressure system has a torque sensor 48 with a first ramp system

50 as well as a second ramp system 52.

The first ramp system 50 has a first input member 54 as well as first output member 56 and the second ramp system 52 has a second input member 58 as well as a second output member 60.

A ramp system of ramp systems 50, 52 is intended for deceleration and a ramp system of those ramp systems 50, 52 is intended for acceleration. Depending on whether acceleration or deceleration is specified, a torque or force is transmitted between the input member and the output member of the particular ramp system. Output member 56 or 60 of that particular ramp system 50, 52 cooperates with the first disk of disk set 14, 16 in such a way that that output member 56 or 60 loads the conical disk 14 in an axial direction, namely as a function of the torque with which the input member 54 or 58 of the particular active ramp system 50, 52 is loaded.

In accordance with the invention it is further preferred that ramps be provided only or also on the input member of the first ramp system 50 and/or the second ramp system 52, and/or only or also on the output member of the first ramp system 50 and/or the second ramp system 52.

In order to load the output member 56 or 60 or the first conical disk 14 with an axially directed force as a function of the torque applied to input member 54 or 58, there is arranged between the particular input member 54 or 58 and the particular output member 56 or 60 a transmission body 62 or 64 that in the exemplary embodiment shown in Fig. 1 is formed as a ball. Several transmission bodies 62 or 64 can also be provided and distributed around the circumference. Output member 56 has a ramp 66 and output member 60 has a ramp 68.

As a function of the torque, which is transmitted to input member 54 or 58, the transmission body 62 or 64 is caused to have a predetermined position on ramp 66 or 68. Because the ramp has a gradient that, for example, has a linear or a nonlinear shape, particularly such as in accordance with exponential course, the input member 54 or 58 is shifted in the axial direction relative to the particular associated output member 56 or 60. It is particularly provided that the respective input members 54 and 58 are rigidly arranged relative to the second conical disk 16. Therewith, by a shifting of the output member 56 or 60 the first conical disk 14 is caused to be shifted in the axial direction relative to the second conical disk 16, or the plate-link chain is loaded with a greater contact pressure force. A gear unit is arranged on the input side of torque sensor 48 which, in the embodiment in accordance with Fig. 1 is formed as a planetary gear 70.

Planetary gear 70 is arranged particularly in the torque flow between a not illustrated internal combustion engine and the torque sensor 48. Planetary gear 70 has a ring gear 72, planet gears 74 as well as a sun gear 76. Planet gears 74 are in each case coupled with each other by a carrier 78.

Input member 54 or 58 is connected with carrier 78.

The carrier moment of the planetary gear is thereby introduced into the input member 54 or 58 of the first ramp system 50 or of the second ramp system 52 or of the torque sensor 48. Sun gear 76 of planetary gear 70 is arranged on a sleeve 80 that further carries an additional gear 82 which in particular has external teeth. That gear engages a gear 84 which is non-rotatably connected with a shaft 86 that can be loaded by an internal combustion engine that is not shown.

Sleeve 80 is non-rotatably connected with shaft 32 so that a torque can be introduced from shaft 86 through gear stage 84, 82 or sleeve 80 and shaft 32 into disk set 14, 16.

The torque, that is introduced into disk pair 14, 16 corresponds substantially with the torque that is introduced into sun gear 76 of planetary gear 70.

Planets 74 on the one hand engage sun gear 76 and on the other hand they engage ring gear 72. Ring gear 72 is non-rotatably coupled to the output member 56 or 60 or to the first conical disk 14 or is coupled through a gear stage 88.

Preferably, the pitch diameter of sun gear 76 is smaller than the pitch diameter of gear 82, which is arranged with the sun gear on the common sleeve 80.

Planetary gear 70 preferably has circular gears.

Fig. 2 shows an exemplary embodiment of the invention in a partial diagrammatic view.

Fig. 2 in particular shows a planetary gear 110 that, for example, can replace planetary gear 70 in an arrangement in accordance with Fig. 1 and that has noncircular gears. Sun gear 112 as well as planet gears 114 of planetary gear 110 are of essentially ellipsoidal form. Ring gear 116 has an essentially star-shaped form in which the transitions are essentially in rounded-off form. The dashed lines 118 indicate a position that the planet gears 114 have as a result of a relative rotation over a predetermined angle of gears 112, 114, 116, and the dashed line 120 indicates the corresponding position of sun gear 112.

Dashed line 122 indicates the movement path through which the axes of the planet gears 114 pass during operation of the planetary gear 110.

Fig. 3 shows an exemplary embodiment of the invention in a partial diagrammatic view.

Between a first disk 14 and a second disk 16 of a set of disks of a continuously variable transmission 10 there is arranged a plate-link chain 18 that serves to transmit torque. The torque sensor 48 has a first ramp system 50 as well as a second ramp system 52, that serve during deceleration or during acceleration to transmit forces or moments from input member 54 or 58 to the first conical disk 14 or conversely. The first ramp system 50 as well as the second ramp system 52 have transmission bodies 62, 64.

Ramp 140 of the first ramp system 50 is connected with ramp 142 of the second ramp system 52 by a spring unit 144.

Between ramp 140 and a component 146, that can be loaded over shaft 148 from an internal combustion engine that is not shown, is arranged a first freewheel, namely especially a conventional freewheel. In a corresponding manner, there is arranged a second freewheel 152 between the ramp 142 and the component 146, which can be loaded by the internal combustion engine that is not shown. By those freewheels 150, 152 it can be caused that, depending on the direction of rotation of the system or the disk sets 14, 16, the loading of the first conical disk 14 in the axial direction is caused by the first ramp system 50 or by the second ramp system 52.

Fig. 3 shows an exemplary, double clamping roll freewheel with outer stars and a common retainer in accordance with the invention, which can be used to control or to establish which ramp system of a contact pressure apparatus in accordance with the invention is to be used for force or moment transmission or

loading of the disk set 14, 16 in the axial direction.

This double clamping roll freewheel 170 has an unprofiled, substantially cylindrically shaped interior track 172, which in that case is formed by the surface of a shaft, as well as two profile-shaped outer tracks 174, 176. The profiled outer track 174 extends radially inward to the surface of a component 178 and the profiled outer track 176 extends to the radially inwardly-lying surface of a component 180.

A first clamping body row 182 is provided radially between the first profiled outer track 174 and the unprofiled inner track 172 and has several clamping bodies 184 that are arranged in a row in the circumferential direction of the double clamping roll freewheel 170.

In a corresponding manner, between the second profiled outer track 176 and the unprofiled inner track 172, viewed in the radial direction, there is provided a second clamping body row 186 that has several second clamping bodies 188 arranged in a row, viewed in the circumferential direction of the double clamping roll freewheel 170.

The unprofiled inner track 172 is associated both with the first clamping body row 182 and the second clamping body row 186, whereby those clamping body rows 182, 186 can in each case be supported, under predetermined conditions, on the unprofiled inner track 172. Components 178, 180 or the first profiled outer track 174 and the second profiled outer track 176 are arranged to be movable relative to each other, namely especially in the circumferential direction of the double clamping roll freewheel 170.

The first clamping bodies 184 of the first clamping body row 182 are arranged

in a retainer 190.

The second clamping bodies 180 of the second clamping body row 186 are arranged in the same retainer 190 as the first clamping bodies 184. In that way one can at least limit or prevent in particular the relative mobility of the first clamping body row with relation to the second clamping body row 182.

The first component 178, not shown in Fig. 4, is preferably connected with an input member 54 of a first ramp system or a torque sensor 48 and the second component 180 or the second profiled outer track 176 is preferably connected with the second input member 58 of a second ramp system or of a torque sensor 48.

Particularly preferred, the double clamp roll freewheel system shown in Fig. 4 is used in an embodiment in accordance with Fig. 3 in place of the freewheels 150, 152, shown there. The corresponding information applies to the double clamping roll or double clamping body freewheels shown in Fig. 5 to 7.

The double clamping roll freewheel shown in Fig. 4 is so configured that in case of a load in a first direction of rotation, the first clamping bodies 184 are releasably clamped or are so arranged between the unprofiled inner track 172 and the first profiled outer track 174 that a torque can be transmitted between those tracks 172, 174 by the first clamping bodies 184, and by loading in the opposite direction of rotation the second clamping bodies 188 will be so arranged or clamped in such a way or in the corresponding manner between the unprofiled inner track 172 and the second profiled outer track 176 that a torque can be transmitted between those two tracks 172, 176.

Preferably a position is provided between those positions, in which a torque

can be transmitted from time to time, in which a torque can be transmitted neither by the freewheel with the first clamping bodies 184 nor by the freewheel with the second clamping bodies 188.

In accordance with the invention it is particularly provided that when a torque can be transmitted between the unprofiled inner track 172 and the first profiled outer track 174 by the first clamping bodies, no torque can be transmitted between the unprofiled inner track 172 and the second profiled outer track 176 by the second clamping bodies 188 and conversely.

As shown in Fig. 4, the profilings 192, 194 of the first profiled outer track 174 or the second profiled outer track 176 are shaped or arranged differently. Those profilings 192, 194 can, however, also have the same contour. From Fig. 4 it is particularly evident that a profiling 192 of the first freewheel, viewed in the circumferential direction and clockwise, has a slight inclination in places, on which the profiling 194 of the second profiled outer track 176 has a larger gradient and conversely. In particular, the first profiled outer track 174 is so configured in the circumferential direction and when running through in the clockwise direction, as the second profiled outer track 176, viewed in the circumferential direction, when running through in the counterclockwise direction.

Fig. 5 shows an exemplary embodiment of the invention in a partial schematic view.

Fig. 5 in particular shows a double clamping roll freewheel with internal stars and a common retainer.

The double clamping roll freewheel 210 in accordance with Fig. 5 has a first

clamping body 184 as well as a second clamping body 188.

The first clamping body 184 is the only clamping body in a first clamping body row 182, or it is one of several clamping bodies 184 that are arranged in the clamping body row in sequence circumferentially.

In a corresponding way, the second clamping body 188 is the only clamping body in a second clamping body row 186, or the second clamping body 188 is one of several clamping bodies in a clamping body row that are arranged in sequence circumferentially.

Clamping bodies 184, 188 are arranged in a common retainer 190.

Radially outside the clamping bodies 184, 188 extends a substantially unprofiled outer track 212 that is an interior surface of a component 214.

The unprofiled outer track 212 is arranged both at the first clamping body 184 and at the second clamping body 188.

Radially inside the first clamping bodies 184 there is provided a first profiled inner track 216, and radially inside clamping bodies 188 there is provided a second profiled inner track 218 that differs from the first profiled inner track 216 and is arranged rotatably opposite the first profiled inner track 216.

The first profiled inner track 216 has a projection 220 and the second profiled inner track 218 has a projection 222, whereby those projections 220, 222 extend in a substantially radial direction and serve as a stop for clamping body 184 or 188.

In the direction facing away from stop 184 or 188, the diameter of the double freewheel system 210 increases relative to the central axis 224.

The stops or projections 220, 222 are arranged in such a way that they act as

stops in different directions of rotation.

The double freewheel system 210 in accordance with Fig. 5 can especially cooperate in such a way with a contact pressure system in accordance with the invention that the first profiled inner track 216 is coupled with the input member of a first ramp system of a torque sensor, and the second profiled inner track 218 is coupled with the second input member of a second ramp system of the torque sensor, whereby the unprofiled outer track 212 or the component 214 is coupled with a component that is loaded by an internal combustion engine.

The double freewheel system shown in Fig. 5 in particular makes it possible that as a function of the rotation or the loading direction of a contact pressure system in accordance with the invention in the circumferential direction, in each case the ramp is switched into the force or moment flow, that is determined for that direction of rotation, thus, especially the in other words, in particular, the acceleration or the deceleration ramp.

Fig. 6 shows an exemplary embodiment of the invention in a partial schematic view.

The double clamping body freewheel system 20 shown in Fig. 6 with a common retainer has a first clamping body row 242 with first clamping bodies 244 as well as a second clamping body row 246 with second clamping bodies 248.

The first clamping body row 242 extends in the circumferential direction of the double clamping body freewheel system in such a way that the first clamping bodies 244 are arranged circumferentially in a row.

The second clamping body row 246 is configured in such a way that the

second clamping bodies 248 are arranged in a row circumferentially relative to the double clamping body freewheel system 240.

The first clamping body row 242 and the second clamping body row 246 or the first clamping bodies 244 and the second clamping bodies 248 are arranged in a common retainer.

The first clamping bodies 244 and the second clamping bodies 248 extend in a radially outward direction at an oblique angle and in the circumferential direction; whereby the first clamping bodies 244 extend in the counterclockwise direction and the second clamping bodies 248 in the clockwise direction, or conversely.

In contrast to the clamping bodies in accordance with Fig. 4 and 5 as well as 7, the clamping bodies in the embodiment in accordance with Fig. 6 are not rollers but other forms of clamping bodies.

Clamping bodies 244, 248 are in each case arranged to be movable in the common retainer 250, specifically particularly in such a way that they are arranged in a tiltable position around axes that are parallel to the central axis 252 of the double clamping body freewheel system 210.

The first 244 and the second clamping bodies 248 have in each case radially outwardly lying ends 254, 256 that are spaced from the respective swing axes. A second clamping body 248 is arranged in the axial direction adjoining a first clamping body 244, whereby the radially outwardly lying end 254 of the first clamping body 244, when viewed in the circumferential direction, is arranged on another side of the associated swing axis than the radially outwardly lying end 256 of the second clamping body 248.

Upon loading in a first direction of rotation, the first clamping body 244 is raised up so that it is jammed between the first unprofiled outer track 258 and the unprofiled inner track 260, so that a torque can be transmitted between those tracks by frictional contact. In that direction of rotation, the second clamping body 248 is in a position in which it does not substantially frictionally connect the second unprofiled outer track 262 with the unprofiled inner track 260. The unprofiled inner track 260 is associated both with the first clamping body 244 and with the second clamping body 248.

Upon loading in the opposite direction of rotation, the conditions are reversed so that the second clamping body 248 is raised up and connects the second unprofiled outer track 262 with the unprofiled inner track 260, while the first clamping body 244 essentially does not connect the first unprofiled inner track 260 in a frictional connection or non-rotating manner.

Fig. 7 shows an exemplary embodiment of the invention that essentially differs from the embodiment in accordance with Fig. 4 in that one or several friction elements or friction disks 280 are provided that operate to hold in frictional connection the clamping roll or clamping body rows with the nonprofiled common running track, thus, here, especially the inner track 172, at least in the area of the "open centers," so that a torque can be transmitted.

The friction element can in particular also be a friction ring or the like.

Fig. 8 shows two graphs in which the switching position of the individual freewheels of a double freewheel is plotted against the rotation angle.

When the first freewheel, indicated by line 290, is in a closed position, the

second freewheel, as indicated by line 292, is in an opened position.

When the second freewheel, on the other hand, as indicated by line 294, is in a closed position, the first freewheel, as indicated by line 292, is in an opened position. Between those rotation angles, in which the first or the second freewheel is in a closed position, there is provided a rotation angle area, indicated by reference numeral 298, in which both the first freewheel and the second freewheel of the double freewheel system are in an opened position.

Fig. 9 shows an exemplary embodiment of the invention in a partial schematic view.

Fig. 9 in particular shows a part of a continuously variable transmission 10 with a first 14 and a second conical disk 16 as well as a plate-link chain 18. There is further shown in Fig. 9 a contact pressure system 12 that can load the first conical disk 14 in the axial direction. Contact pressure system 14 has a torque sensor 48 that has an input member 50 as well an output member 56, whereby transmission bodies 62, 64 are provided between the input member 54 and the output member 56. Contact pressure system 12 or torque sensor 48 further has a first ramp system 50 as well as a second ramp system 52. The first ramp system 50 is provided with a drive flank and the second ramp system 52 is provided with a retard flank. In each case, ramps 66 and 68 are particularly provided, which assist in the transmission of forces and/or moments during deceleration or acceleration between input member 54 and output member 56, or input member 58 by the output member 60, by transmission bodies 62 or 64.

Contact pressure system 12 further has a spring system 310 with springs 312,

314. The spring or the springs 312 are arranged between a component 316 that is loaded by an internal combustion engine and the input member 54 of the first ramp system 50, so that in a force or moment transmission between that component 316 and the input member 54 of the first ramp system 50 those forces or moments are transmitted over spring 312.

In a corresponding way, the internal-combustion-engine-loaded or loadable component 316 is coupled to the input member 58 of the second ramp system 52 by the spring or the springs 314, so that forces are transmitted over spring 314 by a force or moment transmission between component 316 and input member 58 of the second ramp system 52.

Component 316 is non-rotatably connected with shaft 318, which is connected with an internal combustion engine in such a way that that the internal combustion engine can load shaft 318. It is particularly provided that component 316 is an area of shaft 318 or is formed integrally with shaft 318. In accordance with the invention, of course, components 316 are also preferred that are not connected integrally with shaft 318. Springs 312, 314 in particular work in the circumferential direction or at least partially in the circumferential direction.

Input member 54 of the first ramp system 50 or ramp 66 is connected with the input member 58 of the second ramp system 52 or with ramp 68 by a spring unit 320.

It should be noted that when in the sense of the invention a ramp is spoken of, also intended is that a ramp is provided on the output member of the ramp system and/or on the input member of the ramp system. Particularly preferred is that transmission bodies are arranged between two ramps, one of which is arranged on

the input member and one on the output member of a ramp system.

Transmission bodies 62 and 64, that are associated with different ramp systems, are if necessary coupled by a damper unit 322, which particularly is connected parallel to the spring unit 320.

Fig. 10 shows an exemplary embodiment of the invention in a partial schematic view.

Fig. 10 particularly shows a continuously variable transmission 10 that has a first disk set 340 as well as a second disk set 342.

The first disk set 340 can be loaded in an axial direction by a contact pressure system 12 and the second disk set 14', 16' can be loaded by a second contact pressure system 12'.

The first contact pressure system 12 is preferably essentially configured as is the second contact pressure system 12'. The first disk set 340 with contact pressure system 12 corresponds substantially with the one that was explained in connection with Fig. 9.

In a corresponding way, disk set 14', 16' with contact pressure system 12' essentially corresponds with the disk set 14, 16 with contact pressure system 12 explained in connection with Fig. 9 .

Components of the second disk set 342 or the second contact pressure system 12', that substantially corresponds with those of the respective first 340. 12 correspond are provided with the same reference numerals as well as an apostrophe (" ' ").

Fig. 10 shows a system in accordance with the invention in an underdrive

position. In the underdrive position, springs 314, 316, 320 are strongly pressed together, while springs 312', 314', 320' certainly are under tension, but have a lower tension than springs 312, 314, 320.

In an overdrive position, those tension conditions of the springs would be reversed.

Fig. 11 shows an exemplary invention embodiment in accordance with the invention by which to load the second disk set 342 there is provided, in place of a second contact pressure system 12' with a second torque sensor 48', a second contact pressure system 12' with a spindle 350.

A second portion 352 of spindle 350 is axially rigidly connected with the second conical disk 16' and a first portion 354 is accommodated by a nut 356 that is at least axially rigidly connected with the first conical disk 16'. In that case, spindle 350 is supported opposite to the first conical disk 16' by suitable bearing means 358, such as a roller bearing, or a sliding bearing, or a needle bearing, or the like. A rotation of spindle 350 causes a loading of the second conical disk set 342, or a change in the contact pressure force on the second conical disk set 342, or a change of the axial spacing of the conical disks 14', 16' of the second conical disk set 342.

Fig. 12 shows exemplary spring characteristics as a function of the transmission ratio controlled by a continuously variable transmission. Those spring characteristics particularly relate to the transmission springs 314, 314', 316, 316', by which the input member 54, 58, 54', 58' of the torque sensor 48, 48' or of the ramp system 50, 50', 52, 52' is loaded.

From Fig. 12 it can be concluded that at a minimum transmission ratio, the

spring force of spring 314, 316 of the first disk set 340 is at a maximum and falls linearly with increasing transmission ratio, while the spring force of spring 312', 314' of the second disk set 342 is at a minimum at a minimal transmission ratio and rises linearly with increasing transmission ratio.

The spring characteristics in accordance with Fig. 12 relate especially to a system in accordance with Fig. 10.

Fig. 13 shows a further exemplary spring characteristic that can have a spring 312, 314 of a system in accordance with the invention. The spring characteristic in accordance with Fig. 13 relates especially to the illustration in accordance with Fig. 11.

The spring characteristic corresponds substantially with the spring characteristic of the first set of disks 340, that was explained in conjunction with Fig. 12.

The claims included in the application are exemplary and are without prejudice to acquiring wider patent protection. The applicant reserves the right to claim additional combinations of features disclosed in the specification and/or drawings.

The references contained in the dependent claims point to further developments of the object of the main claim by means of the features of the particular claim; they are not to be construed as renunciation to independent, objective protection for the combinations of features of the related dependent claims.

Although the subject matter of the dependent claims can constitute separate and independent inventions in the light of the state of the art on the priority date, the applicants reserve the right to make them the subject of independent claims or

separate statements. They can, moreover, also embody independent inventions that can be produced from the independent developments of the subject matter of the included dependent claims.

The exemplary embodiments are not to be considered to be limitations of the invention. On the contrary, many changes and variations are possible within the scope of the invention in the existing disclosure, in particular such variants, elements, and combinations and/or materials which, for example, are inventive by combining or modifying single features that are in combination and are described individually in relation to the general specification and embodiments as well as the claims and shown in the drawings, as well as elements or method steps that can be derived by a person skilled in the art in the light of the disclosed solutions of the problem, and which by means of combined features lead to a new object or new method steps or sequences of method steps, as well as manufacturing, testing and operational procedures.